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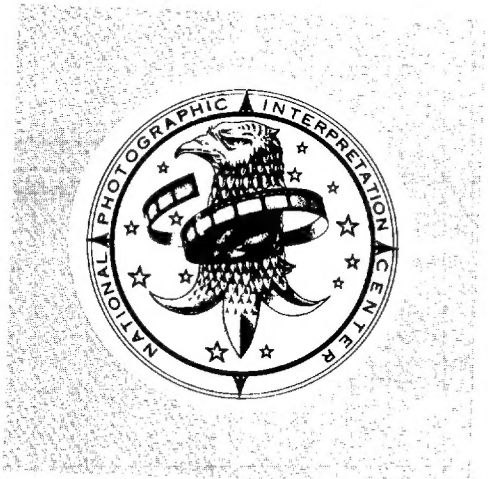

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SUPPLEMENTARY TEST AND EVALUATION REPORT

FJW 2.65X OBJECTIVES
120X CAPABILITY FOR THE ZOOM 240 SYSTEM

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NPIC/R-07/74
FEBRUARY 1974

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Comments and queries regarding this report are welcomed.
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1. INTRODUCTION

The FJW 120X Capability for the Zoom 240 System consists of 15X eyepieces and 2.65X stereo objectives. This report contains the results of comparative testing between the prototype B&L 2.65X objective and the preproduction FJW 2.65X objectives. The prototype B&L 120X Capability for the Zoom 240 System was tested and reported in T&E Report NPIC/R-14/73, October 1973. Since the FJW 15X eyepieces are not scheduled for delivery until March 1974, the B&L 15X eyepieces and a Zoom 240 pod with accompanying rhomboid arms were used to complete the system. The primary consideration for these comparative tests was to determine if the FJW objective is as good or better than the original B&L objective. With the delivery of the FJW 15X eyepieces, these tests will be repeated with the complete FJW 120X capability.

2. SUMMARY OF TEST RESULTS

Tests	B&L 2.65X	FJW 2.65X
Maximum Magnification	110	110
Distortion at 110X for 77% of FOV	13 % ±2.7%	12 % ±2.7%
Eye Relief at 110X	20 mm	20 mm
Diameter of FOV at 110X	2.65 mm	2.65 mm
Resolution (TEB #80)		
40X	143 lp/mm	143 lp/mm
120X	456 lp/mm	456 lp/mm
Working Distance at 110X	6.5 mm	6.7 mm
Visual Transmission at 110X	0.92%	0.88%
Viewing Port Transmission	3.8%	7.5%
Spectral Characteristics	- See Figure 1 -	

3. CONCLUSION

The results of the test show that the FJW objective is as good or better than the B&L objective. All the tests that were conducted indicate that the objectives were practically the same except for viewing port transmission. The FJW objective showed an approximate two times increase in light output through the viewing ports. This highly desirable increase in luminance through the viewing ports was accomplished without a significant sacrifice of transmission through the regular optical path.

4. TEST RESULTS

4.1 Magnification

Magnification was measured using a theodolite with a diopter telescope mounted on it. Measurements were made with the B&L 15X eyepieces (Serial No. 53999486), B&L Zoom 240 pod (#158BF), B&L rhomboid arms (#962WF), and FJW objective (#A). The measurements were repeated with the B&L objective (#53999467). The zoom was set at 3.0X through all the tests.

Since the focus on the objectives can affect magnification, the measurements were done with the focus knob turned all the way in and repeated with the knob turned all the way out. With the knob turned in, the FJW objective/Zoom 240 system produced a magnification of 110.1X while the B&L objective/Zoom 240 system produced a magnification of 110.2X. With the focus all the way out, the FJW objective/Zoom 240 system produced a magnification of 106.9X versus 106.7X for the B&L objective/Zoom 240 system. In addition, the magnification of five other FJW objectives was measured with the Zoom 240 system. In each case the magnification was within 0.5% of 110.5X with the focus knob all the way in.

4.2 Distortion

The same setup for magnification was also used to measure distortion. The FJW distortion was approximately 12% while the B&L distortion was 13%. Both measurements were made at 77% of the field and at 110X magnification.

4.3 Eye Relief

Eye relief was measured with a vernier caliper and a piece of ground glass mounted on it. Both the B&L and FJW setup produced an eye relief of 20 mm at 110X magnification.

4.4 Field of View

Field of view was measured at 110X with a Maxta reticle scale with 0.1 mm increments. The diameters of the field of view for both the B&L and FJW setup was 2.65 mm.

4.5 Resolution

Resolution was measured at two magnifications using three observers. TEB Resolution Target #80 was used in this test. At 40X the resolution was 143 lp/mm for both setups. At 110X the results were also the same at 456 lp/mm. A cursory examination of off-axis resolution detected no significant differences between the B&L and FJW objectives.

4.6 Working Distance

The B&L objective/Zoom 240 system has a working distance of 6.5 mm while the FJW objective/Zoom 240 system has a working distance of 6.7 mm. The difference between the two is within measurement error. A vernier caliper was used to make the measurements.

4.7 Visual Transmission

Visual transmission was measured with the UDT-11A photometer and microscope sensor head. The sensor was positioned 20 mm away from the top surface of the eyepiece. Luminance was measured to be 23 fL at the eyepiece for the FJW setup and 24 fL for the B&L setup. The source was measured with both the Weston light meter and UDT photometer to be 2,600 fL. The transmission (visual) was then calculated to be approximately 0.9% for both objective/Zoom 240 systems.

4.8 Viewing Port Transmission

Measurements were taken with the Spectra Spot Brightness meter and a +3 diopter lens for closeup work. The viewing port transmission of the B&L objective was measured at 3.8% while the FJW viewing port produced an average transmission of 7.5% over six objectives. The range of transmission for the FJW objective viewing ports was from 6.6% to 9.4%.

4.9 Spectral Characteristics

Spectral characteristics were measured with a Gamma 3000 spectroradiometer. The accompanying plot (on Figure 1) shows the two spectral energy distributions of the light coming through the optical systems. The source is an [redacted] 1540 light table (Serial No. 013, left).

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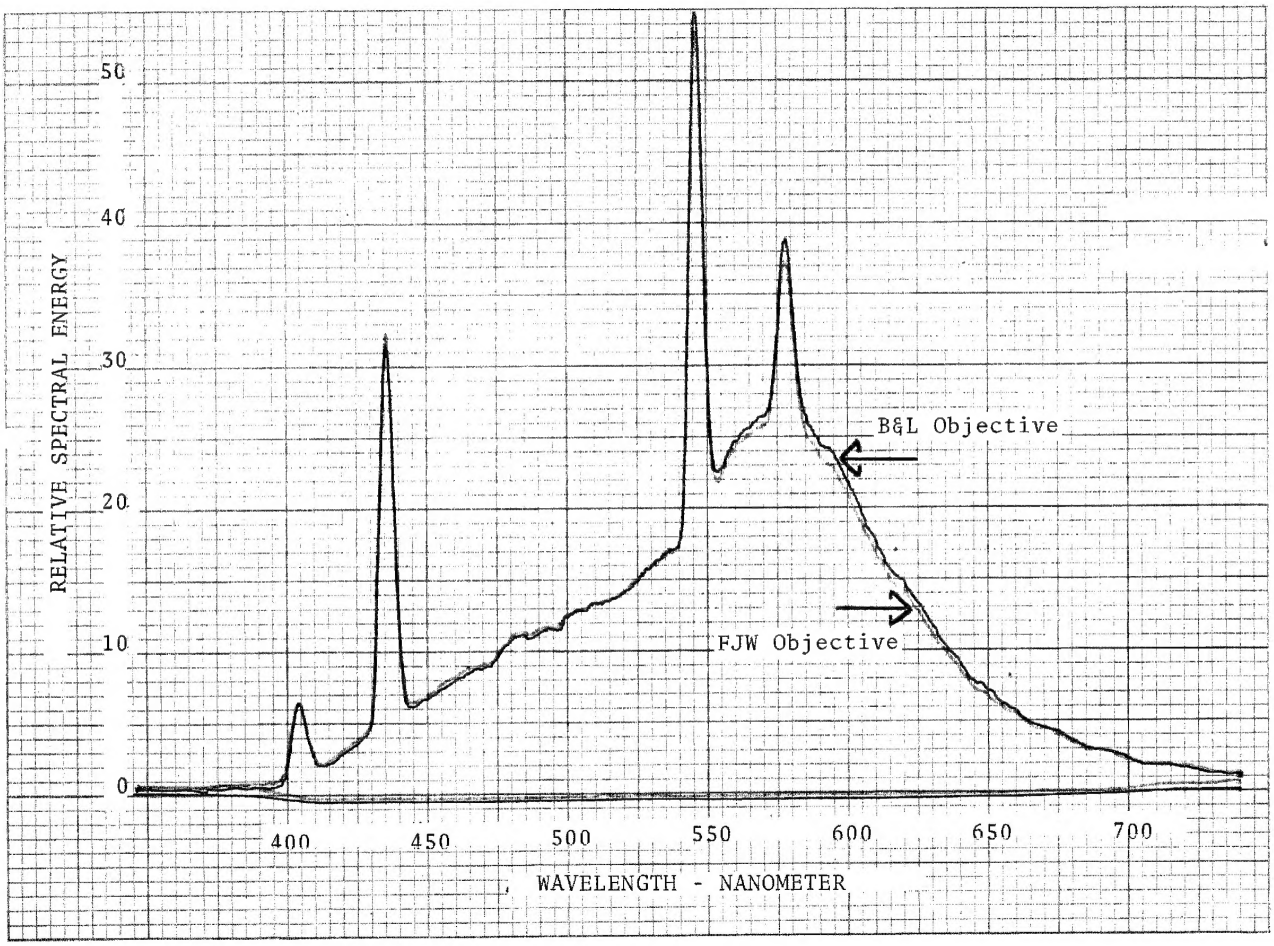

FIGURE 1 - SPECTRAL CHARACTERISTICS

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